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Egocentric contact networks of older adults: featuring quantity, strength and function of ties

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This article analyzes how the theory of constraints, the socio-emotional and functional selectivity theories can explain the egocentric networks of older adults. The contact diary method is applied on a randomly chosen subsample of a nationally representative cross-sectional sample in Hungary enumerating all active ties and encounters with social contacts of 181 adults aged 50 and above. Age is negatively associated with network size, but it is positively correlated with average tie strength. Retirement, declining health, and death of the partner act as external constraints, and are associated with a shrinking network. Our results support the socio-emotional selectivity theory, but not the functional selectivity theory.

Keywords: contact diary, social networks, tie strength, network size, network composition

Introduction

High-quality, loving, supportive interpersonal ties are important for human well-being in all age groups, and this is especially true for older adults (Baker et al., 2005; Fiori et al., 2007). Empirical evidence shows that loneliness and the prevalence of social isolation increase with advancing age (Wenger & Burholt, 2004). With aging, one does not only need emotional but also increasingly instrumental support. At the same time older people may have more time and capacity to nurture their relationships.

Several studies on the network of older adults (e.g., Badawy et al., 2019; Stoeckel & Litwin, 2013) collected data on very specific aspects of the interpersonal networks, but the results are interpreted as if they applied to the whole egocentric network of older adults. The various network generators (e.g., the name generator or position generator) produce measures of artificial networks instead of real ones, and the results are exposed to several biases such as recall biases (Fu, 2005, 2007; McCarty et al., 1997).

This paper analyses the interpersonal egocentric network of adults aged 50 and above. Using a randomly chosen subsample of a nationally representative sample from Hungary, it examines how network size, network composition, tie strength, and multiplexity vary by age in this aging population by using a unique methodology: the contact diary method (Dávid, Barna, et al., 2016; Dávid, Huszti, et al., 2016; Fu, 2005, 2007). Contact diary registers interpersonal contacts in everyday life; thus, all the active ties of the older adults are revealed. The diary also records the alters' socio-demographic characteristics and other relevant information on the relationship between ego and each alter.

The contribution of our paper is primarily empirical and practical, but the paper might have theoretical relevance as well. Previous studies mostly focused on data from Western Europe and the United States. Evidence from Eastern Europe is missing,

although the region is special, regarding both the socio-economic and network characteristics of older adults. Compared to other well-developed regions, health status and mortality rates are worse (Lindholm Eriksen et al., 2013; OECD/EU, 2016), the average retirement age is lower (European Commission, 2011), the prevalence of loneliness is higher (Shiovitz-Ezra, 2015), interpersonal networks are smaller, and family members are more important confidants (Stoeckel & Litwin, 2013).

Thus far, research has not been able to verify the advantages of the contact diary approach on nationally representative samples. Our study is the first of its kind. Based on such a rich sample, a comprehensive examination of the interpersonal networks not only helps us better understand the challenges and problems older adults face due to their changing social network but can also help identify methods to improve their social embeddedness.

We test the theory of constraints, the socio-emotional selectivity theory, and the functional selectivity theory (see Harling et al., 2018) that might explain the patterns of the interpersonal egocentric networks of older adults using the contact dairy method. Moreover, the contact diary approach allows us not only to gather conventional measures of social connectedness but also to use a theory-based index of tie strength, applying Granovetter's classical definition (Granovetter, 1973).[i]

Theoretical background

Network characteristics of the aging population

The characteristics of social networks have proved to be a key aspect of life course and are also relevant in the study of aging. According to the convoy model (Kahn & Antonucci, 1980), the personal network structure changes with age. The characteristics

of convoys are influenced by personal and situational factors and have significant implications, related to, e.g., health and well-being. Several studies found that network size shrinks with age (Ajrouch et al., 2005; Cornwell, 2011; Cumming & Henry, 1961; Harling et al., 2018; Kohli et al., 2009; Marsden, 1987; van Tilburg, 1998), and networks become more kin-dominated (Ajrouch et al., 2005; Antonucci & Akiyama, 1987; Cornwell et al., 2008; Fredrickson & Carstensen, 1990; Marsden, 1987). Although there are important cross-national differences between the social networks of older adults, at an individual level, the main characteristics are strikingly similar across different nations (Kohli et al., 2009; Lancee & Radl, 2012).

According to Harling et al. (2018), the changes the social networks of older adults undergo might be explained by two groups of theories that are not mutually exclusive and might explain different facets of network development among the older adults. The first is based on the social and economic changes that come with aging (e.g., retirement, diminishing health, changes in the life of their adult children). The second one is based on the assumption that the changes in the network characteristics of older adults are the result of conscious choices.

Theory of constraint

According to the theory of constraint, different life stages and life events, such as retirement, widowhood, or worsening health status, can affect network size, composition, and the frequency of contact with network members. Relationships may not only come and go, but their closeness, quality, and function may also change. Leaving the labor market can induce significant changes in social networks. It does not necessarily mean deterioration or a decrease, as retired people can take on new activities, such as looking after their grandchildren, joining formal or informal associations, etc. (Litwin, 2010; van Tilburg, 1998). People may lose some

relationships, mainly those with colleagues, but new relationships (already existing in the latent network or brand new ones) can replace them (Starker et al., 1993; van Tilburg, 1998). The other major reason behind the decrease in network size is deteriorating health conditions/physical limitations (Abuladze & Sakkeus, 2013; van Tilburg, 1998). Chronic conditions may have a negative impact on one's relationships. They limit mobility and thus affect older adults' ability to meet with others, and also hinder their ability to reciprocate support, which is particularly relevant in voluntarily established relationships, such as friendships (Klein Ikkink & van Tilburg, 1999). The third reason is that romantic relationships have a prominent role in adults' interpersonal networks. Thus, the loss of the partner (widowhood) is another important factor in shaping networks.

Theories of choice

Theories of choice highlight that the decrease in network size can reflect adaptive behavior, socio-emotional, or functional selectivity. There is evidence that social relationships that remain throughout older age are more satisfying and emotionally fulfilling (Lansford et al., 1998). Previous studies found that older adults have more positive emotions about their social relationships than younger adults, they also perceive social support as increasing with age (Charles & Piazza, 2007; Field & Minkler, 1988; Schnittker, 2007). Cornwell et al. (2008) found that age affects network size negatively, but it has a positive impact on contact frequency with neighbors, and participation in religious and voluntary activities. Other investigations found that changes in the social network can be observed in the periphery rather than in the core of the network (Carstensen, 1992; Kahn & Antonucci, 1980; Shulman, 1975; van Tilburg, 1992, 1998).

The socio-emotional selectivity theory (SST) claims that with aging, the number of interpersonal ties decreases, but people try to maintain emotional intensity and invest more emotions in their remaining ties, while also becoming more able to handle them (Carstensen, 1995). The underlying factor behind this is that in different life stages, different functions (need for information, maintaining a positive emotional state, need for intimacy, etc.) of social ties come to the foreground, and this is reflected in the formation, the number, and the nature of interpersonal ties. Emotional goals are more important for older adults, while accessible information is less so (Charles & Carstensen, 1999). Since older people also become more conscious of the limited timeframe of life, they select relationships based on the intensity of the emotional experience, gained from social ties in a decreasing interpersonal network (Carstensen, 1995). This means that with aging, people tend to focus on the maintenance of emotionally meaningful ties. In line with this, other studies also indicated that although the size of the interpersonal networks often shrink as people grow older, older adults tend to evaluate their remaining ties more positively (Lansford et al., 1998). Older adults are more satisfied with their social interactions and experience these interactions less negatively than young people (e.g., Fingerman, Hay, & Birditt, 2004). In their close relationships, positive emotions are more intense, and negative ones are less so, compared to those of young adults (Charles & Piazza, 2007). Older adults perceive their close relationships to be more supportive (Field & Minkler, 1988; Schnittker, 2007), and their ties with their children, partner and close friends to be of better quality than the ties of middle-aged or young adults. Furthermore, they account for more positive relationships than negative ones (Fingerman et al., 2004; Rook, 2003). Interpersonal conflicts also seem to decrease with age; older people report fewer disputes and quarrels (Almeida & Horn, 2004). Some researchers found that even in personal conflicts, older

adults tend to evaluate both their own and their partners' emotions and behaviors more positively and therefore feel less angry (Blanchard-Fields & Coats, 2008).

On the other hand, the functional selectivity theory (FST) claims that older adults maintain contacts who fulfill specific functions (Lang et al., 2002; Smith et al., 2015), i.e., the multiplexity of ties – the overlap of functions or roles in a relationship – decreases with age. However, there is not much evidence to support the FST. For example, Smith et al. (2015) found that age is negatively associated with multiplexity in the general population. They report *increasing* multiplexity for three out of the six network relations of older people (in the subgroup above the age of 60-70). Similarly, Harling et al. (2018) found no evidence of network patterns predicted by FST in a sample of older South Africans.

Hungary

In Hungary, the proportion of the 65+-year-old population increased from 13 percent to 19 percent between 1990 and 2017 and is forecasted to reach 29 percent by 2070 (European Union, 2017, p. 22; Monostori, 2015, p. 117). There are more women than men in the older population due to women's better survival rates. This gap widens further with age.

Three age groups are often distinguished within the older population: the 'young old' (65–75), the 'older old' (75–85), and the 'oldest old' (85+). According to population data, the number of the 85+ year-olds doubled between 1990 and 2016, while that of those between 65-75 years increased by more than 30 percent, and there were more than 20 percent more 75-85 year-olds than two decades earlier (Spéder, 2019, p. 29). Both the objective and subjective health status of the Hungarian older adults are quite negative, which, based on international survey evidence, have a significant link to the characteristics of social networks. About one-third of the 65+-year-old consider their

health bad or very bad, and 80 percent have a chronic disease (Monostori, 2015, p. 132; Monostori & Gresits, 2018, p. 138). Since 1990, the proportion of older adults living alone has been increasing; in 2016, 31 percent of 65+ year-olds lived alone. The importance of having a partner is paramount in the networks of older adults. In addition, there is a very marked gender difference in the country: older men in all age groups live in a romantic relationship at a significantly higher rate than women. Family ties of women seem stronger than those of men, as more than 20 percent of women living alone have strong, daily contact with their child(ren) who live in a separate household, as opposed to 5 percent of men in the same situation (Monostori & Gresits, 2018, pp. 134–136).

Knowledge about the interpersonal network characteristics of Hungarian older adults, especially in an international context, is quite limited. SHARE study results indicate that the core discussion networks of the Hungarian older adults are smaller than those in other countries in the study, while the partner and children play a more, while friends a less significant role in them (Litwin et al., 2013; Stoeckel & Litwin, 2013).

While physical limitations decreased the size of the core networks in all countries in the study, Hungary was among the countries with the highest rate of those who had at least one supportive tie in such situations. These were mainly family members, among them with high probability, children (Abuladze & Sakkeus, 2013). Although the proportion of older adults living in institutional care has increased since the 1970s, it is still quite low, due to the limited capacities, quality and affordability, and negative attitudes toward these living arrangements both among the older adults themselves and their family members (Monostori & Gresits, 2018).

Challenges arising from population aging are as important in Hungary as in other European countries. Being a post-communist country and a relatively new member state

of the European Union where welfare regimes have undergone a very different trajectory than the 15 older Member States, a country-specific analysis will add a useful variation to our current understanding of the social networks of the older populations. The theories under scrutiny have never been tested on data from the Central-European region, although surveys of the general adult population have all indicated a significant decline in the size of interpersonal networks with aging (Albert & Dávid, 2018; Höllinger & Haller, 1990). If Hungarian data also support the theories in focus, it may be interpreted as a step forward in their generalisability.

Hypotheses

We tested how the three theories (the theory of constraint, the socio-emotional selectivity theory, and the functional selectivity theory) can explain the patterns of the interpersonal egocentric network of older adults.

1. It was expected that age is negatively associated with network size. If the theory of constraint can explain the decreasing number of relations; retirement, the absence of a partner, or health status are responsible for this decrease. This means that if these three variables are included in our analysis, we can expect that age differences become smaller.

2. According to SST, older people maintain or select relationships that are stronger or emotionally more meaningful. Although their networks become smaller, they also become denser, more kin-centric, and the ties become stronger on average. Previous papers showed that kinship-based ties are stronger (Dávid, Huszti, et al., 2016; Marsden & Campbell, 1984). Thus, we hypothesize that if the proportion of kin-relations, the proportion of stronger ties, and the average strength of ties are higher in older age groups, the results will support SST.

3. FST predicts that older people maintain or select relationships for specific functions. A decreasing level of multiplexity would support FST. We tested whether contacts indeed fulfill fewer functions in older age groups.

Methods and materials

Contact diary approach

The most common measures of personal networks are based on one of the various network generators (e.g., name generator, position generator, or resource generator). These generators rely on the memory of the respondents and produce proxy measures of networks rather than actual networks (Fu, 2007; McCarty et al., 1997). Hence, the results based on these measures are exposed to several biases. For example, recalling a full list of network members might be a problem for many respondents. Thus, there might be a bias toward stronger ties (Marin, 2004) or, at the same time, network members who are socially close but do not provide the examined resources might be neglected (Chua et al., 2011).

Among the alternative instruments aiming to measure more subsets of egocentric networks and to reconstruct the components of networks that are active in everyday life, the contact diary has many outstanding features that make it the right choice (Dávid, Barna, et al., 2016; Dávid, Huszti, et al., 2016; Fu, 2005, 2007; Huszti et al., 2013). Rather than asking respondents to provide a list of the members of their personal social network, the contact diary method asks them to track and record all their interpersonal contacts (interactions) in a given period. This way, it measures daily contacts by which it can 'tap into the core element of egocentric networks more directly and more comprehensively' (Fu, 2005, p. 172). The most basic approach of the contact diary registers the socio-demographic characteristics of the alters; however, more

sophisticated and exhaustive information might also be gathered: e.g., the socio-economic statuses of the alters, the circumstances of each interaction, or the characteristics of the relationship between ego and alter (Fu, 2007).

The contact diary approach has several advantages, and it can avoid measurement errors (Fu, 2008). Measuring daily contacts makes the researchers able to collect information on ties of various strengths while avoiding biases towards either stronger or weaker ties (Chua et al., 2011; Fu, 2005). Another strength of the diary approach is that it is 'more familiar, natural, and unobtrusive to respondents' (Fu, 2007, p. 196). Overall, while network generators provide proxy measures of a subset of the personal network and limit the number of alters to list, the contact diary approach aims to give information about a whole range of ties or 'a complete profile of personal networks within a specific time period' without restricting their number. (Fu, 2008, p. 52) However, it is also worth noting that following the contact diary approach is very tedious and demanding, as it requires more time and more effort from both researchers and respondents (Dávid, Barna, et al., 2016; Fu, 2007; Killworth et al., 2006).

In order to utilize the originally very demanding method in a nationally representative sample, the respondents were asked to list all interactions for two consecutive days, i.e., they had to record every interaction with the same person separately. To minimize the chance of leaving out important, but less frequently contacted ties of one's egocentric networks, we also asked the respondents to list every important alter with whom they did not have contact during the two days.

We put great emphasis on the training of the interviewers, and we prepared a very systematic and detailed instruction for both the interviewers and the respondents based on our previous experiences. Although the diary was self-administered, all respondents had to fill out the 'first line' of the diary (the first interaction) with the assistance of the

interviewer. The interactions that needed to be recorded were thoroughly defined: practically all of them, except those that did not go beyond a greeting. We were interested in all kinds of interactions: contacts occurring face-to-face, over the phone (voice or text messages), or via the internet (e-mail or chat).

The diary-log consisted of three major parts: (1) The type and (in case of face-to-face contacts) the place of interaction, (2) the individual and socio-demographic characteristics of the alter, (3) the characteristics of the relationship. First, respondents had to name the contacted person. They could record the name, nickname, or the initials of the alter. Then we asked whether the interaction occurred face-to-face, over the phone, on VoIP (e.g., Skype, Viber) or via text message (e.g., Facebook messenger, Viber chat, SMS). The length and place of the interaction (for a face-to-face interaction) were also reported. In the second part of the diary log, the characteristics of the alter were explored. Besides the traditional socio-demographic variables (gender, age, education), the type of relationship (e.g., spouse/registered partner, partner, parent, current neighbor, current colleague, etc.), as well as the origin (e.g., family/kinship, neighbor, school, etc.), and duration of the acquaintanceship were also recorded. In the third part of the diary log, we asked questions about the relationship with the contacted person (e.g., the ego trusts the alter, how important is the alter for the ego, whether they discuss their important problems, whether they ask for help from each other).

Data

Our analysis is based on a nationally representative Hungarian survey conducted by the Institute of Sociology of the Hungarian Academy of Sciences and the TÁRKI Social Research Institute in 2015[ii]. A randomly chosen subsample of the main survey sample filled out the contact diary on two consecutive days. This contact diary sample consisted

of 358 respondents, 181 of whom were of 50 years of age or older. These 181 respondents registered 1,813 interactions with 1,018 individuals and 332 other important relations whom they did not meet during the two days covered by the contact diary.

Variables

The age of the respondents was measured with monthly precision and was grouped into four categories (50-56, 57-62.5, 62.5-70, 71+ years). Since in 2015, the retirement age was 62.5 in Hungary, this classification can reflect the possible effects of retirement.

The size of the personal network was measured with four indicators. (1) The number of alters reflects the number of individuals listed in the contact diary (including the list of other important people with whom they did not have an interaction during the two diary days). Using the information on the type of the relationship, we calculated (2) the number of kin relations and (3) the number of non-kin relations. (4) The number of interactions during the two days was calculated as the sum of the registered interactions in the contact diary.

Network composition was measured with (1) the proportion of close family members (spouse, parents, children, and siblings), (2) the proportion of other family members, and (3) the proportion of non-kin relations in the network.

The strength of tie index (SoT) was based on ten questions about the relationship with the alters, which were designed to be able to measure Granovetter's dimensions of tie strength (Granovetter, 1973). We created an index that takes values from 0 to 1, where the larger values indicated a stronger tie. (Detailed description of the SoT index is in the Appendix – Table A1.) Then for each respondent, we calculated the average strength of their ties. We also created three variables that measured the proportion of the low

strength (0.00-0.25 points), medium strength (0.25-0.75), and high strength (0.75-1.00) ties in the network.

Multiplexity is defined by Verbugge (1979, p. 1286) as "the overlap of roles, exchanges, or affiliations in a social relationship". In this analysis, we focus on the multiplexity of exchanges in social relations. The multiplexity of the ties was measured by three questions:

(1) How typical is it that you and the given person talk about important things?

(2) How typical is it that you share your personal problems with the given person?

(3) How typical is it that you ask for help/favor/money from the given person?

Respondents could answer the questions on a four-point scale (1=not at all 2=rather no, 3=rather yes, 4=very much). We created a multiplexity score ranging from 1 to 4 as the mean of the three variables. Then we calculated a mean multiplexity score for each respondent that measured the average of their ties' multiplexity scores. As a second variable, we used the share of entirely multiplex ties among a respondent's ties. A tie was labeled entirely multiplex if the respondent's answer was 'very much' to all three questions.

Health was measured by subjective activity limitations. The respondents were asked if they were hampered in their daily activities in any way by any long-standing illness, disability, or mental health problem. A detailed household table was used to create an indicator variable for having a partner. The respondents were categorized as working if they were employed, self-employed, had an odd job or contractual work or participated in public work.

Empirical strategy

We compared the network characteristics of age groups using OLS regression:

$$Y_i = \beta_0 + \beta_1 A_i^j + \beta_2 \mathbf{X}_i + \varepsilon_i$$

where Y is the network variable, A is a vector of variables indicating the age group of the respondents, and $\mathbf{X}$ is the vector for the socio-demographic characteristics of the respondents.[iii]

Results

Sample demographics

Summary statistics are shown in Table 1. The average age of the respondents is 64.6 years. They are nearly evenly distributed in the four age groups, similarly to the age distribution of the Hungarian older population. One-fifth (19.9 percent) live in the capital, 51.4 percent in other towns, and 28.7 percent in villages, which is, again, not different from the Hungarian older population. Most of the respondents (69.1 percent) are female, and this is somewhat higher than in the whole population.

About half of the sample (54.7 percent) is living with a partner, and 32.6 percent are working full- or part-time. Half of the sample is not limited in their daily activity due to long-standing illness, disability or mental health problems, 34.3 percent has some activity limitation, and 14.9 percent described themselves as ’hampered a lot’.

The average network size is 7.5, which is roughly evenly divided between kin and non-kin relations. 36.2 percent of the ties are high-strength ties, 20.5 percent are medium-strength ties, and 43.2 percent are low-strength ties. About one-third of the ties are entirely multiplex, whereas the average multiplexity score of the respondents’ ties is 3.05 (on a four-point scale).

Insert Table 1.

Network size

Table 2 shows how network size differs between age groups. Column 1 shows that the number of alters is significantly smaller above the age of 62.5 than before. The coefficients are substantial in magnitude: the 57-62.5-year-olds have 2.7 fewer alters (or a 29 percent smaller network), whereas those who are above the age of 71 have 3.1 fewer alters (or a 34 percent smaller network) than the 50-56-year-olds. When we control for the three main variables that might be related to network size (health, having a partner, being employed, or self-employed), the estimated coefficients become much smaller and insignificant (Column 2).

The differences in the number of kin and non-kin relations are reported in Column 3 and Column 5, respectively. Older people (above the age of 62.5) have 1.2-1.3 fewer kin relations and 1.6-2.2 less non-kin relations, compared to people between the age of 50-56: they lost more non-kin relations than kin-relations. Again, when we control for socio-demographic variables, the estimated differences are smaller and insignificant (Column 4 and Column 6).

The number of interactions is lower for individuals above the age of 62.5: they reported four fewer interactions (during the two diary days) than the 50-56-year-olds, which is a substantial, 33 percent difference (Column 7). Again, these differences disappear when controlling for the socio-demographic background (Column 8).

These results can be considered as the results of a simple decomposition approach. The odd columns show the raw differences between age groups, whereas the even columns show the estimated residual differences when age groups share the same observable characteristics (working status, health, and having a partner). These results indicate that a substantial part of the differences in network size between the age groups can be explained by worsening health status over time, retirement, and the loss of the partner.

However, it is worth noting that age differences remain relatively large regarding the number of alters and the number of non-kin relations even after controlling for the three external constraints.

Retirement seems to be the most important factor in the case of three out of the four indicators. In models including only the indicator variable of whether the respondent was working or not, the size of the age group coefficients is halved for the number of alters (Appendix, Model 4 in Table A6) and for the number of non-kin relations (Appendix, Model 4 in Table A8), whereas it is reduced to one fourth for the number of interactions (Appendix, Model 4 in Table A9). This means that the residual gaps between the age groups adjusted for working status are considerably smaller than the raw gaps. In models including only either health status (Model 3 in the same tables) or having a partner (Model 2 in the same tables), the decrease of the age-coefficients is smaller. For the number of kin relations, it was observed that the largest decrease was in the size of the coefficients when we controlled for having a partner, which seems to be the most important factor regarding kin ties (Appendix, Model 2 in Table A7). This is not surprising given that partners themselves are kin ties.

In models where additional socio-demographic variables (sex, education, income, type of settlement) were included, the change of the age-coefficients was small (last columns of Table A6 - Table A9). This suggests that, indeed, a large part of age differences can be explained by retirement, worsening health, and losing the partner.

Insert Table 2

As a robustness test, we carried out Oaxaca−Blinder decompositions, recoding the four groups into two age groups (below age 62.5 and above age 62.5), using coefficients of the older age group on the covariates to remove composition effects. Table A10 shows the fraction of the raw gap the three external constraint variables explain. The

conclusion based on these models is similar to the conclusion of our main model: differences in working status explain the largest part or one of the two largest part of the age differences in three indicators of network size, whereas having a partner explains a large part of the age differences in the number of alters and number of kin ties.[iv]

Network composition

Table 3 reports network composition differences between the four age groups. The proportion of close family members in the network is similar in all ages, regardless of controlling for socio-demographic characteristics (Column 1 and 2). The proportion of other family members is 6.2 percentage points higher (Column 3), whereas the proportion of non-kin relations is 9.9 percentage points lower in the network of the oldest individuals (Column 5). However, when socio-demographic variables are controlled for, the point estimates become slightly smaller and are insignificant at the 10 percent level, primarily due to the small sample size. The results seem to be in line with SST, which suggests that older people are more likely to maintain kin relationships. It seems that 'other kin' relations have increasing importance in the everyday life of older adults – primarily compared to non-kin relations.

Insert Table 3

Strength of ties

Table 4 reports the results of models testing SST by comparing the average strength of the ties and the proportion of low-, medium- and high-strength ties between the age groups. The mean strength of the relations is 0.140 points (or 34.4 percent) higher in the oldest group than in the youngest group (Column 1), and the coefficient remains significant at the 5 percent level when the socio-demographic variables are included in the model (Column 2). Column 3 shows that the proportion of low-strength ties is 13.9

percentage points lower, whereas Column 7 shows that the proportion of high-strength ties is 15.2 percentage points higher above the age of 71 than in the youngest group. Both coefficients remain significant after controlling for the socio-demographic characteristics of the respondents (Column 4 and Column 8). There is no difference in medium-strength relations (Column 5 and Column 6). These results support SST, which predicts that older people might have smaller networks, but those networks consist of stronger ties.

Insert Table 4

Multiplexity

Table 5 show the results of models testing the functional selectivity theory. Column 1 shows that the mean multiplexity score is 0.28 points higher above the age of 71 than among the 50-56-year-olds, which is a sizeable, 9.3 percent difference compared to the average multiplexity score in the youngest group (2.94). The relationship between multiplexity and age is U-shaped, with multiplexity being the lowest in the age-group of 57.0-62.5 years. Column 2 shows the results when the socio-demographic variables are included. The coefficients became smaller and lost their significance. However, when the oldest group is compared to the 57-62.5-year-olds (with the lowest multiplexity score), the difference is significant at the 10 percent level (p=0.081). The difference between the 62.5-71-year-olds and the 57-62.5-year-olds is also significant (p=0.038). The proportion of entirely multiplex relations is 14.0 percentage points (or 50.2 percent) higher among the oldest individuals than among the 50-56-year-olds (Column 3). Again, multiplexity is U-shaped in age. When the youngest age group is the reference category, the control variables make the age coefficients insignificant (Column 4). However, if we compare the older age groups to the 57-62.5-year-olds, the differences are significant at the 10 percent level both for the 62.5-71-year-olds (p=0.098) and for

the 71-plus-year-olds (p=0.083). These results do not support FST, which predicts that ties with specific functions are maintained by older individuals.

Insert Table 5

Limitations

Some limitations of our study should be noted. First, we used cross-sectional data that allowed us to analyze associations rather than to draw causal inferences. The exact mechanisms behind our results remained unanswered. For example, we do not know whether older people focus on maintaining stronger, emotionally more significant ties, or the remaining ties in their shrinking networks become more important for them. The results that the number of kin ties decreases less than the number of non-kin ties does, and that the proportion of non-kin ties decreases with aging seem to support the latter hypothesis. However, instead of indirect evidence, future research is needed. Second, although egocentric network characteristics are supposed to vary by gender (Cornwell, 2011; Harling et al., 2018), due to the relatively small sample size, we cannot analyze the heterogeneity of our results by gender.

Discussion and conclusion

In this paper, we analyzed the interpersonal egocentric network of older people in Hungary using a unique methodology, the contact diary method.

Using the contact diary approach, we examined how network size, network composition, tie strength, and multiplexity vary by age within the aging population. We had data about all the active ties of the older adults rather than very specific aspects of their interpersonal networks (e.g., core discussion network, weak ties). We tested how three theories (the theory of constraints, the socio-emotional selectivity theory, and the

functional selectivity theory) can explain the patterns of the interpersonal egocentric networks of older adults.

In line with previous papers (e.g., Ajrouch et al., 2005; Cornwell, 2011; Harling et al., 2018; Smith et al., 2015), we found that age is negatively associated with network size, i.e., older people have smaller networks. We also showed that a substantial part of these age differences could be explained by physical limitations, the labor force status (retirement) and the loss of the partner, which supports that retirement, worsening health, and the death of the partner act as external constraints and are associated with a shrinking network (see Cornwell, 2011; Harling et al., 2018). Our results also suggest that retirement is the most important one of the three factors, which is supported by previous findings that showed that in Hungary, the workplace has traditionally been a very, if not the most important source of friendship ties (Höllinger & Haller, 1990; Utasi, 1992). The end of employment is coupled with the loss of friendship ties. This implies that the size of the networks of older adults might be sustained if workplace communities could be replaced by participation in other voluntary associations, senior clubs, or other social or hobby activities. These types of interventions seem especially important in light of the changing composition of the aging population. The numbers of the very old have grown the most dynamically; and the very old represent an increasing proportion of those living alone.

Our results also support the socio-emotional selectivity theory. We found that the proportion of family members is somewhat higher, and the proportion of non-kin relations is somewhat lower in the network of older people. More importantly, age is also positively correlated with the average strength of ties, whereas the proportion of high strength ties is higher, and the proportion of low strength ties is lower in the

network of the oldest age group, even when socio-demographic characteristics are controlled for. Overall, these results show the pattern that SST predicts.

As to our third hypothesis concerning FST, our findings do not support its claims. Our data indicate that the relationship between multiplexity and age is U-shaped, with multiplexity being lowest in the age group 57.0-62.5 years and the highest among the 71-plus-year-olds. This seems to be reasonable since older people have fewer contacts; consequently, they have to rely on a smaller pool of alters for a similar range of functions. These results contradict other papers that found that multiplexity declines with age (Harling et al., 2018; Smith et al., 2015). However, these studies measured network relations using the name generator approach, that collects information about contacts fulfilling specific functions (mostly confidential, intimate relations), and it can be biased toward stronger ties (Marin, 2004). It is also worth noting that although Smith et al. (2015) found that age is negatively associated with multiplexity, their results are less conclusive for older people, as they report increasing multiplexity above age 60-70 for several network indicators.

This study is the first, to our knowledge, to use the contact diary approach on a randomly chosen subsample of a nationally representative sample to analyze the egocentric network ties of an aging population. Although previous studies used the American Time Use Survey (ATUS) to measure the time spent in social contact (Cornwell, 2011; Marcum, 2013), and time-use diaries has some similarities to the methodology of the contact diary (European Union, 2019), the contact diary approach has advantages even over these papers. First, time-use diaries focus on activities, whereas the contact diary focuses on realized contacts. Using the contact diary, respondents are asked to concentrate on their interactions and social relations; therefore, it is more suitable for studying the social network characteristics of older people.

Moreover, it provides more sophisticated, comprehensive, and exhaustive information about how older adults maintain and activate their social contacts. Also, detailed characteristics of alters and the relationship with the alters can be collected rather than collecting information only on the role of the alters (e.g., spouse, friend) like in the time-use diaries. Second, in the ATUS, data were not collected about work-related contacts, i.e., it covers only a special part of the respondents' contacts.[v]

With the contradictory finding on multiplexity, our paper points out an important issue: diverse empirical approaches are needed to understand all aspects of the personal network system. Methods that register all active ties and encountered social contacts more diversely than standard network generators allow researchers to answer more complex questions in social gerontology. Since 9% of the older people consider themselves lonely most of the time, and frequent loneliness is reported by 40% in Europe (Vozikaki et al., 2018) and loneliness is common among the very old (Dykstra, 2009), a more complex picture of older people's personal social network may help provide them with more effective care. The contact diary approach might serve as a key instrument in this process.

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Notes

[i] According to Granovetter, "the strength of a tie is a (probably linear) combination of the amount of time, the emotional intensity, the intimacy (mutual confiding) and the reciprocal services which characterize the tie" (Granovetter, 1973, p. 1361).

[ii] "Integrative and Disintegrative Processes in the Hungarian Society" doi:10.17203/KDK387 (http://openarchive.tk.mta.hu/387/)

[iii] As robustness test, we also used negative binomial regressions for count outcomes, fractional probit regressions (using fracreg command of Stata) for proportion outcomes, and Tobit regression for the continuous multiplexity score variable that is censored between 0 and 3. These results are shown in Table A1: Granovetter's dimensions of strength of tie and its operationalization in the contact diary

Table A2-Table A5 and are substantively equivalent to the results of the OLS regressions. Moreover, in these models, the significance of the age group coefficients is consistently lower than in the OLS regressions. We have decided to use OLS, since interpreting the coefficients is easier and it has heuristic advantages.

[iv] However, retirement explains the largest part of the age differences in number of kin relations when partners are not counted in number of ties (Model 3 in Table A10).

[v] On the other hand, ATUS includes data on one day, which is close to the two days contact diary used in the present study. Although previous contact diary studies used longer timeframes (Fu, 2005; Huszti et al., 2013), still, the two-days contact diary shares the main methodology of contact diaries that makes it different from the ATUS survey and papers analyzing the time spent in social contact.

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Tables

Table 1: Summary statistics

	Mean	SD	Min	Max	N
Network size	7.459	5.036	1	29	181
Number of kin relations	3.597	2.900	0	16	181
Number of non-kin relations	3.862	3.340	0	18	181
Number of interactions	10.017	6.996	0	37	181
Close family members in the network	0.366	0.257	0	1	181
Other family members in the network	0.135	0.168	0	0.67	181
Non-kin in the network	0.499	0.263	0	1	181
Mean strength of the ties	0.456	0.216	0	1	180
Low strength ties in the network	0.432	0.276	0	1	180
Medium strength ties in the network	0.205	0.238	0	1	180
High strength ties in the network	0.362	0.296	0	1	180
Mean multiplexity score	3.051	0.555	1.67	4	181
Entirely multiplex ties	0.328	0.297	0	1	181
Age	64.635	8.814	50.08	89.58	181
Age: 55.00-56.99	0.227	0.420	0	1	181
Age: 57.00-62.49	0.232	0.423	0	1	181
Age: 62.50-70.99	0.276	0.448	0	1	181
Age: 71.00+	0.265	0.443	0	1	181
Female	0.691	0.464	0	1	181
Living with partner	0.547	0.499	0	1	181
Working	0.326	0.470	0	1	181
No activity limitation	0.508	0.501	0	1	181
Some activity limitation	0.343	0.476	0	1	181
Activity limitation: a lot	0.149	0.357	0	1	181
Budapest (capital)	0.199	0.400	0	1	181
Bigger city	0.193	0.396	0	1	181
Town	0.320	0.468	0	1	181
Village	0.287	0.454	0	1	181
Equivalent income (log form)	11.661	0.459	10.03	13.12	156

Table 2: Network size by age group

	(1) Number of alters	(2) Number of alters	(3) Kin	(4) Kin	(5) Non-kin	(6) Non-kin	(7) Number of interactions	(8) Number of interactions
Age: 50.00-56.99	ref.	ref.	ref.	ref.	ref.	ref.	ref.	ref.
Age: 57.00-62.49	-0.384	0.419	-0.269	0.004	-0.308	0.341	-2.041	-0.160
	(1.221)	(1.246)	(0.682)	(0.639)	(0.763)	(0.848)	(1.635)	(1.761)
	[0.754]	[0.737]	[0.693]	[0.994]	[0.687]	[0.688]	[0.214]	[0.928]
Age: 62.50-70.99	-2.682	-1.510	-1.277	-0.712	-1.611	-0.807	-4.147	-0.570
	(1.012)	(1.361)	(0.576)	(0.733)	(0.651)	(0.924)	(1.547)	(2.074)
	[0.009]	[0.269]	[0.028]	[0.332]	[0.014]	[0.384]	[0.008]	[0.784]
Age: 71.00+	-3.143	-1.387	-1.150	-0.248	-2.160	-1.095	-4.041	0.422
	(1.006)	(1.421)	(0.640)	(0.778)	(0.624)	(0.962)	(1.529)	(2.054)
	[0.002]	[0.330]	[0.074]	[0.751]	[0.001]	[0.257]	[0.009]	[0.837]
Controls	no	yes	no	yes	no	yes	no	yes
Adjusted R-squared	0.059	0.100	0.019	0.105	0.055	0.075	0.042	0.153
N	181	181	181	181	181	181	181	181

OLS regressions. Control variables: labor force status (working), living with partner, activity limitation.
Robust standard errors are in parentheses, p-values are in brackets.

Table 3: Network composition by age group

	(1) Close family members	(2) Close family members	(3) Other family members	(4) Other family members	(5) Non-kin	(6) Non-kin
Age: 50.00-56.99	ref.	ref.	ref.	ref.	ref.	ref.
Age: 57.00-62.49	-0.027	-0.066	0.031	0.012	-0.005	0.053
	(0.044)	(0.046)	(0.032)	(0.032)	(0.046)	(0.048)
	[0.546]	[0.155]	[0.324]	[0.701]	[0.920]	[0.266]
Age: 62.50-70.99	-0.022	-0.028	0.029	0.032	-0.007	-0.004
	(0.049)	(0.052)	(0.031)	(0.030)	(0.050)	(0.052)
	[0.663]	[0.588]	[0.356]	[0.283]	[0.888]	[0.936]
Age: 71.00+	0.037	0.046	0.062	0.041	-0.099	-0.087
	(0.052)	(0.057)	(0.035)	(0.035)	(0.054)	(0.058)
	[0.480]	[0.421]	[0.076]	[0.243]	[0.070]	[0.135]
Controls	no	yes	no	yes	no	yes
Adjusted R-squared	-0.007	0.063	0.000	0.043	0.009	0.114
N	181	181	181	181	181	181

OLS regressions. Control variables: Sex, education, type of settlement, equivalent income.
Robust standard errors are in parentheses, p-values are in brackets.

Table 4: Strength of the ties by age group

	(1) Mean strength of the ties	(2) Mean strength of the ties	(3) Low strength ties	(4) Low strength ties	(5) Medium strength ties	(6) Medium strength ties	(7) High strength ties	(8) High strength ties
Age: 50.00-56.99	ref.	ref.	ref.	ref.	ref.	ref.	ref.	ref.
Age: 57.00-62.49	-0.013	-0.019	0.005	0.025	0.022	0.002	-0.027	-0.027
	(0.041)	(0.039)	(0.056)	(0.057)	(0.044)	(0.047)	(0.056)	(0.052)
	[0.760]	[0.628]	[0.926]	[0.667]	[0.619]	[0.961]	[0.629]	[0.603]
Age: 62.50-70.99	0.049	0.040	-0.028	-0.030	-0.040	-0.032	0.068	0.062
	(0.040)	(0.040)	(0.056)	(0.055)	(0.049)	(0.050)	(0.058)	(0.058)
	[0.223]	[0.317]	[0.617]	[0.591]	[0.418]	[0.520]	[0.245]	[0.285]
Age: 71.00+	0.140	0.103	-0.139	-0.119	-0.013	0.004	0.152	0.116
	(0.042)	(0.046)	(0.057)	(0.060)	(0.051)	(0.050)	(0.058)	(0.065)
	[0.001]	[0.027]	[0.015]	[0.047]	[0.800]	[0.945]	[0.009]	[0.076]
Controls	no	yes	no	yes	no	yes	no	yes
Adjusted R-squared	0.062	0.075	0.030	0.056	-0.008	0.011	0.039	0.031
N	180	180	180	180	180	180	180	180

OLS regressions. Control variables: Sex, education, type of settlement, equivalent income.
Robust standard errors are in parentheses, p-values are in brackets.

Table 5: Multiplexity by age group

	(1) Mean multiplexity score	(2) Mean multiplexity score	(3) Entirely multiplex ties	(4) Entirely multiplex ties
Age: 50.00-56.99	ref.	ref.	ref.	ref.
Age: 57.00-62.49	-0.052	-0.073	-0.049	-0.039
	(0.112)	(0.109)	(0.055)	(0.053)
	[0.642]	[0.505]	[0.374]	[0.470]
Age: 62.50-70.99	0.164	0.158	0.086	0.066
	(0.113)	(0.113)	(0.058)	(0.058)
	[0.148]	[0.164]	[0.141]	[0.262]
Age: 71.00+	0.276	0.143	0.140	0.083
	(0.110)	(0.126)	(0.058)	(0.066)
	[0.013]	[0.255]	[0.017]	[0.211]
Controls	no	yes	no	yes
Adjusted R-squared	0.039	0.044	0.045	0.048
N	181	181	181	181

OLS regressions. Control variables: Sex, education, type of settlement, equivalent income.
Robust standard errors are in parentheses, p-values are in brackets.

Supplementary tables

The SoT index

The SoT index has four subindexes: (1) amount of time, (2) emotional intensity, (3) intimacy, (4) reciprocal services. The SoT is based on ten questions, shown in Table A1. For every dimension, we calculated the mean of the variables in the dimension. Lastly, we created the SoT index as the mean of the four-dimensional indicators.

Table A1: Granovetter's dimensions of strength of tie and its operationalization in the contact diary

Dimension	Information in the contact diary	Strong relationship	%
Amount of time	Since when have they known each other?	More than 35 years	34.1
	How frequently do they talk to each other?	Daily contact	31.7
Emotional intensity	How much does ego like alter?	Very much (4 on a 1-4 scale)	53.1
	How important is alter for ego?	Very important (4 on a 1-4 scale)	51.7
Intimacy	How typical is that ego and alter talk about important things?	Very typical (4 on a 1-4 scale)	35.7
	How much does ego trust alter?	Very much (4 on a 1-4 scale)	48.8
Reciprocity	How typical is that ego shares her/his personal problems with alter?	Very typical (4 on a 1-4 scale)	34.4
	How typical is that alter shares his/her personal problems with ego?	Very typical (4 on a 1-4 scale)	36.6
	How typical is that ego asks help/favor/money from alter?	Very typical (4 on a 1-4 scale)	31.9
	How typical that alter asks help/favor/money from ego?	Very typical (4 on a 1-4 scale)	32.9

Table A2: Network size by age group, Negative binomial regressions

	(1) Number of alters	(2) Number of alters	(3) Kin	(4) Kin	(5) Non-kin	(6) Non-kin	(7) Number of interactions	(8) Number of interactions
Age: 50.00-56.99	ref.	ref.	ref.	ref.	ref.	ref.	ref.	ref.
Age: 57.00-62.49	-0.043	0.071	-0.064	0.016	-0.064	0.121	-0.175	-0.004
	(0.136)	(0.140)	(0.162)	(0.151)	(0.159)	(0.180)	(0.138)	(0.143)
	[0.752]	[0.610]	[0.691]	[0.916]	[0.686]	[0.500]	[0.206]	[0.979]
Age: 62.50-70.99	-0.348	-0.180	-0.351	-0.168	-0.394	-0.203	-0.395	-0.044
	(0.128)	(0.172)	(0.152)	(0.190)	(0.164)	(0.233)	(0.144)	(0.182)
	[0.007]	[0.294]	[0.021]	[0.374]	[0.016]	[0.383]	[0.006]	[0.810]
Age: 71.00+	-0.422	-0.177	-0.310	-0.035	-0.573	-0.310	-0.383	0.044
	(0.133)	(0.181)	(0.173)	(0.205)	(0.174)	(0.244)	(0.140)	(0.181)
	[0.001]	[0.328]	[0.073]	[0.866]	[0.001]	[0.204]	[0.006]	[0.810]
Controls	no	yes	no	yes	no	yes	no	yes
Pseudo R-squared	0.015	0.029	0.009	0.037	0.016	0.026	0.009	0.034
N	181	181	181	181	181	181	181	181

Negative binomial regressions. Control variables: labor force status (working), living with partner, activity limitation.
Robust standard errors are in parentheses, p-values are in brackets.

Table A3: Network composition by age group, Fractional probit regressions

	(1) Close family members	(2) Close family members	(3) Other family members	(4) Other family members	(5) Non-kin	(6) Non-kin
Age: 50.00-56.99	ref.	ref.	ref.	ref.	ref.	ref.
Age: 57.00-62.49	-0.072	-0.182	0.158	0.077	-0.012	0.138
	(0.118)	(0.121)	(0.156)	(0.157)	(0.114)	(0.118)
	[0.544]	[0.131]	[0.313]	[0.625]	[0.919]	[0.243]
Age: 62.50-70.99	-0.058	-0.084	0.146	0.175	-0.018	-0.015
	(0.132)	(0.137)	(0.155)	(0.151)	(0.125)	(0.128)
	[0.661]	[0.537]	[0.347]	[0.247]	[0.887]	[0.909]
Age: 71.00+	0.096	0.123	0.291	0.190	-0.250	-0.230
	(0.134)	(0.146)	(0.157)	(0.158)	(0.137)	(0.145)
	[0.473]	[0.403]	[0.064]	[0.230]	[0.068]	[0.113]
Controls	no	yes	no	yes	no	yes
Pseudo R-squared	0.002	0.031	0.005	0.037	0.005	0.038
N	181	181	181	181	181	181

Fractional probit regressions. Control variables: Sex, education, type of settlement, equivalent income.
Robust standard errors are in parentheses, p-values are in brackets.

Table A4: Strength of the ties by age group, Fractional probit regressions

	(1) Mean strength of the ties	(2) Mean strength of the ties	(3) Low strength ties	(4) Low strength ties	(5) Medium strength ties	(6) Medium strength ties	(7) High strength ties	(8) High strength ties
Age: 50.00-56.99	ref.	ref.	ref.	ref.	ref.	ref.	ref.	ref.
Age: 57.00-62.49	-0.033	-0.050	0.013	0.062	0.073	0.019	-0.079	-0.081
	(0.106)	(0.099)	(0.138)	(0.141)	(0.146)	(0.153)	(0.162)	(0.146)
	[0.758]	[0.615]	[0.925]	[0.658]	[0.616]	[0.900]	[0.627]	[0.581]
Age: 62.50-70.99	0.124	0.104	-0.070	-0.079	-0.145	-0.112	0.184	0.178
	(0.101)	(0.098)	(0.139)	(0.137)	(0.179)	(0.179)	(0.156)	(0.152)
	[0.217]	[0.289]	[0.613]	[0.567]	[0.420]	[0.529]	[0.237]	[0.240]
Age: 71.00+	0.354	0.262	-0.362	-0.317	-0.045	0.027	0.402	0.313
	(0.107)	(0.113)	(0.148)	(0.154)	(0.177)	(0.175)	(0.152)	(0.165)
	[0.001]	[0.020]	[0.014]	[0.040]	[0.799]	[0.877]	[0.008]	[0.057]
Controls	no	yes	no	yes	no	yes	no	yes
Pseudo R-squared	0.011	0.021	0.011	0.031	0.003	0.032	0.016	0.033
N	180	180	180	180	180	180	180	180

Fractional probit regressions. Control variables: Sex, education, type of settlement, equivalent income.
Robust standard errors are in parentheses, p-values are in brackets.

Table A5: Multiplexity by age group, Tobit and fractional probit regressions

	(1) Mean multiplexity score	(2) Mean multiplexity score	(3) Entirely multiplex ties	(4) Entirely multiplex ties
Age: 50.00-56.99	ref.	ref.	ref.	ref.
Age: 57.00-62.49	-0.036	-0.054	-0.154	-0.126
	(0.116)	(0.108)	(0.173)	(0.165)
	[0.755]	[0.617]	[0.375]	[0.444]
Age: 62.50-70.99	0.195	0.184	0.240	0.192
	(0.119)	(0.115)	(0.160)	(0.158)
	[0.103]	[0.112]	[0.134]	[0.225]
Age: 71.00+	0.310	0.176	0.381	0.227
	(0.116)	(0.128)	(0.157)	(0.172)
	[0.008]	[0.173]	[0.015]	[0.187]
Controls	no	yes	no	yes
Pseudo R-squared	0.031	0.067	0.019	0.042
N	181	181	181	181

Mean multiplexity score: Tobit regressions. Entirely multiplex relations: fractional probit regressions. Control variables: Sex, education, type of settlement, equivalent income.
Robust standard errors are in parentheses, p-values are in brackets.

Table A6: Number of alters by age groups, OLS

	(1) Number of alters	(2) Number of alters	(3) Number of alters	(4) Number of alters	(5) Number of alters	(6) Number of alters
Age: 50.00-56.99	ref.	ref.	ref.	ref.	ref.	ref.
Age: 57.00-62.49	-0.384	-0.180	0.136	0.390	0.419	0.579
	(1.221)	(1.179)	(1.197)	(1.293)	(1.246)	(1.209)
Age: 62.50-70.99	-2.682***	-2.295**	-2.239**	-1.306	-1.510	-1.626
	(1.012)	(0.979)	(1.057)	(1.379)	(1.361)	(1.355)
Age: 71.00+	-3.143***	-2.325**	-2.393**	-1.703	-1.387	-0.911
	(1.006)	(1.002)	(1.060)	(1.415)	(1.421)	(1.438)
Living with partner		2.315***			2.068***	1.527*
		(0.714)			(0.762)	(0.792)
Activity limitation: no			ref.		ref.	ref.
Activity limitation: some			-1.127		-0.614	-1.093
			(0.904)		(0.968)	(0.919)
Activity limitation: lot			-2.178**		-1.256	-1.845
			(0.864)		(1.031)	(1.312)
Working				1.633	0.690	0.479
				(1.216)	(1.352)	(1.251)
Female						1.051
						(0.858)
Education: primary						ref.
Education: vocational						-0.502
						(1.144)
Education: secondary						0.442
						(1.111)
Education: tertiary						3.028**
						(1.461)
Type of settlement: capital						ref.
Large town						0.916
						(0.981)
Small town						1.856**
						(0.833)
Village						3.764***
						(1.164)
Income: lowest quintile						ref.
4. quintile						-1.002
						(1.872)
3. quintile						-1.316
						(1.640)
2. quintile						-0.519
						(1.657)
Highest quintile						-0.381
						(1.627)
Adjusted R^2	0.059	0.103	0.071	0.064	0.100	0.146
N	181	181	181	181	181	181

Robust standard errors are in parentheses.
* p<0.1, ** p<0.05, *** p<0.01

Table A7: Number of kin relations by age groups, OLS

	(1) Kin	(2) Kin	(3) Kin	(4) Kin	(5) Kin	(6) Kin
Age: 50.00-56.99	ref.	ref.	ref.	ref.	ref.	ref.
Age: 57.00-62.49	-0.269	-0.099	-0.149	-0.025	0.004	-0.227
	(0.682)	(0.640)	(0.681)	(0.663)	(0.639)	(0.636)
Age: 62.50-70.99	-1.277**	-0.954*	-1.171**	-0.843	-0.712	-0.818
	(0.576)	(0.544)	(0.567)	(0.711)	(0.733)	(0.780)
Age: 71.00+	-1.150*	-0.469	-0.973	-0.696	-0.248	-0.260
	(0.640)	(0.631)	(0.628)	(0.782)	(0.778)	(0.783)
Living with partner		1.930***			1.950***	1.722***
		(0.413)			(0.425)	(0.442)
Activity limitation: no			ref.		ref.	ref.
Activity limitation: some			-0.274		0.146	-0.081
			(0.485)		(0.510)	(0.493)
Activity limitation: lot			-0.486		0.260	-0.369
			(0.554)		(0.614)	(0.731)
Working				0.516	0.350	0.223
				(0.605)	(0.713)	(0.716)
Female						0.449
						(0.458)
Education: primary						ref.
Education: vocational						-1.426**
						(0.571)
Education: secondary						-0.010
						(0.591)
Education: tertiary						0.642
						(0.786)
Type of settlement: capital						ref.
Large town						0.480
						(0.608)
Small town						1.002**
						(0.499)
Village						1.669**
						(0.662)
Income: lowest quintile						ref.
4. quintile						0.118
						(0.981)
3. quintile						-1.320*
						(0.794)
2. quintile						-0.459
						(0.855)
Highest quintile						-0.886
						(0.911)
Adjusted R^2	0.019	0.119	0.012	0.017	0.105	0.160
N	181	181	181	181	181	181

Robust standard errors are in parentheses.
* p<0.1, ** p<0.05, *** p<0.01

Table A8: Number of non-kin relations by age groups, OLS

	(1) Non-kin	(2) Non-kin	(3) Non-kin	(4) Non-kin	(5) Non-kin	(6) Non-kin
Age: 50.00-56.99	ref.	ref.	ref.	ref.	ref.	ref.
Age: 57.00-62.49	-0.308	-0.272	0.127	0.346	0.341	0.734
	(0.763)	(0.766)	(0.764)	(0.854)	(0.848)	(0.835)
Age: 62.50-70.99	-1.611**	-1.543**	-1.248*	-0.449	-0.807	-0.876
	(0.651)	(0.648)	(0.705)	(0.922)	(0.924)	(0.934)
Age: 71.00+	-2.160***	-2.015***	-1.541**	-0.943	-1.095	-0.602
	(0.624)	(0.620)	(0.738)	(0.937)	(0.962)	(1.013)
Living with partner		0.408			0.115	-0.264
		(0.471)			(0.503)	(0.492)
Activity limitation: no			ref.		ref.	ref.
Activity limitation: some			-0.911		-0.771	-1.003
			(0.646)		(0.728)	(0.670)
Activity limitation: lot			-1.873***		-1.604*	-1.510*
			(0.658)		(0.825)	(0.908)
Working				1.380*	0.566	0.442
				(0.826)	(0.971)	(0.911)
Female						0.537
						(0.585)
Education: primary						ref.
Education: vocational						0.920
						(0.812)
Education: secondary						0.554
						(0.709)
Education: tertiary						2.600***
						(0.924)
Type of settlement: capital						ref.
Large town						0.722
						(0.702)
Small town						1.200**
						(0.553)
Village						2.394***
						(0.715)
Income: lowest quintile						ref.
4. quintile						-1.384
						(1.298)
3. quintile						-0.087
						(1.225)
2. quintile						-0.112
						(1.234)
Highest quintile						0.655
						(1.196)
Adjusted R^2	0.055	0.054	0.083	0.067	0.075	0.155
N	181	181	181	181	181	181

Robust standard errors are in parentheses.
* p<0.1, ** p<0.05, *** p<0.01

Table A9: Number of interactions by age groups, OLS

	(1) Number of interactions	(2) Number of interactions	(3) Number of interactions	(4) Number of interactions	(5) Number of interactions	(6) Number of interactions
Age: 50.00-56.99	ref.	ref.	ref.	ref.	ref.	ref.
Age: 57.00-62.49	-2.041	-1.621	-1.537	-0.233	-0.160	-0.361
	(1.635)	(1.538)	(1.684)	(1.895)	(1.761)	(1.698)
Age: 62.50-70.99	-4.147***	-3.352**	-3.706**	-0.934	-0.570	-0.619
	(1.547)	(1.492)	(1.593)	(2.186)	(2.074)	(1.994)
Age: 71.00+	-4.041***	-2.362	-3.300**	-0.678	0.422	0.997
	(1.529)	(1.535)	(1.606)	(2.137)	(2.054)	(1.953)
Living with partner		4.755***			4.663***	3.931***
		(1.032)			(1.080)	(1.141)
Activity limitation: no			ref.		ref.	ref.
Activity limitation: some			-1.140		0.435	-0.326
			(1.194)		(1.239)	(1.200)
Activity limitation: lot			-2.051		0.840	-0.816
			(1.336)		(1.345)	(1.591)
Working				3.814**	3.523**	3.462**
				(1.741)	(1.783)	(1.605)
Female						1.875*
						(1.028)
Education: primary						ref.
Education: vocational						-1.284
						(1.502)
Education: secondary						1.632
						(1.387)
Education: tertiary						2.252
						(1.840)
Type of settlement: capital						ref.
Large town						0.712
						(1.244)
Small town						2.066*
						(1.117)
Village						5.066***
						(1.553)
Income: lowest quintile						ref.
4. quintile						-3.227
						(2.059)
3. quintile						-3.322*
						(1.979)
2. quintile						-3.279
						(1.985)
Highest quintile						-3.772*
						(2.014)
Adjusted R^2	0.042	0.146	0.042	0.066	0.153	0.200
N	181	181	181	181	181	181

Robust standard errors are in parentheses.
* p<0.1, ** p<0.05, *** p<0.01

Table A10: The share of external constraints in explaining age differences using two age groups (below age 62.5 and above age 62.5), Oaxaca−Blinder decomposition

	(1) Number of alters	(2) Number of kin relations	(3) Number of kin relations (without partner)	(4) Number of non-kin relations	(5) Number of interactions
Working	12%	21%	26%	15%	74%
Living with partner	16%	38%	23%	2%	32%
Activity limitation	6%	-5%	-6%	14%	-5%
Unexplained	66%	46%	57%	70%	-1%
Total	100%	100%	100%	100%	100%

Notes: The table shows the fraction of the raw gap between two groups of older adults (below age 62.5 and over age 62.5) the three external constraint variables explain using Oaxaca−Blinder decomposition. In Column 3, we used a modified measure of the number of kin relations: partners were excluded.